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THE EFFECTIVENESS OF DIFFERENT FORMS OF SUPPLEMENTATION AS
ADJUNCTS TO PROGRAMED LEARNING, A FOLLOW-UP STUDY.

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STUDENT TEACHER RELATIONSHIP

THIS STUDY FURTHER DEVELOPS A DISCOVERY MADE BY AN
EARLIER STUDY--THAT SYSTEMATIC TEACHER SUPPLEMENTATION OF
PROGRAMED LEARNING IS MORE EFFECTIVE THAN RANDOM OR NO
SUPPLEMENTATION. IN THE PRESENT STUDY, SETS OF 5 SIXTH GRADE
CLASSES FROM EACH OF 3 SCHOOLS STUDIED A PROGRAMED TEXT,
"WORDS," FOR 25 MINUTES EACH DAY FOR 3 WEEKS. READING
ABILITY, THE MATCHING VARIABLE FOR COMPARING THE 15 CLASSES,
WAS MEASURED BY THE GATES READING SURVEY. FOLLOWING STUDY OF
THE PROGRAM, 5 METHODS OF SUPPLEMENTATION WERE USED--(1) THE
TEACHER LECTURED ON CONCEPTS COVERED IN THEIR PROGRAMED
ORDER, (2) TEACHER CONDUCTED RECITATION FROM PREPARED
QUESTIONS FOLLOWING PROGRAMED ORDER, (3) STUDENTS CHECKED
THEIR OWN COVERT RESPONSES AGAINST ANSWER BOOKLET, (4)
TEACHER CONDUCTED RECITATION FROM PREPARED QUESTIONS IN
RANDOM ORDER, (5) TEACHER LED RANDOM CLASS DISCUSSION ON
CONCEPTS COVERED. RESULTS OF A FINAL TEST FOLLOWING THE
EXPERIMENTAL PERIOD WERE ADJUSTED FOR DIFFERENCES IN READING
LEVEL. FINDINGS WERE THAT ORDERLY LECTURE AND RECITATION
PRODUCED HIGHER LEARNING THAN RANDOM DISCUSSION AND COVERT
RESPONSES. IT WAS THUS CONFIRMED THAT THE MOST EFFECTIVE
PROGRAM SUPPLEMENTATION IS A SYSTEMATIC LIVE TEACHER
PRESENTATION. A DELAYED POSTTEST REVEALED THE SAME TENDENCIES
AS THE FINAL TEST. RELATED QUESTIONS ARE DISCUSSED. (MS)

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A

TYPE OF TEACHER HELP •• AND PROGRAMED LEARNING

(A FOLLOW-UP STUDY)

EM000503

Random

Systematic

*Question
and
Answer*

*Thoroughness
and
Sequence*



Louis Bruno

State Superintendent of Public Instruction

Olympia

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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THE EFFECTIVENESS OF DIFFERENT FORMS OF SUPPLEMENTATION
AS ADJUNCTS TO PROGRAMED LEARNING
(A Follow-up Study)

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The Columbia Basin School Study Council is due special thanks for its excellent
cooperation in this study. Participating school districts included:

Moses Lake
Quincy

Soap Lake
Ephrata

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administrators from these districts for their time, effort and most cooperative
attitude in this research effort.

* * * * *

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Ray E. Jongeward
Director of Research
Office of State Superintendent of Public Instruction
Olympia, Washington

June 1963

WASHINGTON STATE UNIVERSITY

PULLMAN, WASHINGTON

COLLEGE OF EDUCATION

June 27, 1963

Mr. Louis Bruno
Superintendent of Public Instruction
Olympia, Washington

Dear Mr. Bruno:

The study reported here was made possible by a grant from your office. The College of Education at Washington State University and the Columbia Basin Research Council have been interested in the changes which appear to be taking place in the role of the teacher due to the application of new educational medium. One dimension of this important problem is the changed function of the classroom teacher where programmed learning devices are used. This was the focal point of the enclosed study. Our research staff believes that some general principles have become clear concerning this particular problem, thanks to the assistance of your office.

Besides the specific information gained from the research, we believe that the state-wide research program under the leadership of your office has stimulated wholesome patterns of cooperative study between institutions of higher learning and public schools. We believe that this study is an example of such cooperative research. We believe that your office is pioneering a promising and productive means for the improvement of instruction in the schools of the State of Washington.

We are indeed grateful for the grant and assistance from your office.

Respectfully yours,

Zeno B. Katterle
Zeno B. Katterle
Dean of College of Education

ZBK:vw

Enclosure

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THE EFFECTIVENESS OF DIFFERENT FORMS OF SUPPLEMENTATION
AS ADJUNCTS TO PROGRAMED LEARNING

Background for Study

The theory basic to programed learning is that the material to be learned is best presented in very small steps, prepared in a sequence which has intrinsic merit to the content. The pupil learns through being reinforced by the program at each step. The nature of reinforcement is the pupil's knowledge that his response is correct. Programed learning materials thus both provide stimuli and reinforce the pupils' responses. In this sense, programs teach.¹ The implication of this theory is that the human teacher is extra baggage on the programed road to learning. On the other hand, some studies and much practical experience suggest that the teacher can provide at least secondary reinforcement to the learner. This reinforcement which the teacher supplies may well be critical in classroom applications of programed learning theory.

This study attempted to refine a discovery made by research financed by the State Superintendent of Public Instruction and completed in 1962.² In that study, two sets of five classrooms of ninth-grade algebra students studied mathematics set theory for 25 minutes each day. In each set, four of the classes utilized the program, Modern Mathematics--Book 2.³ The fifth class was taught by

¹An example of the particular program used in this study is included in Appendix 2.

²H. Hite and L. Wriggle, "The Amount and Nature of Teacher Help Necessary for Optimum Achievement Through Use of Programed Learning Devices," Research Report No. 05-01, State Superintendent of Public Instruction, Olympia, Washington, 1962.

³Modern Mathematics--Book 2, Science Research Associates

a teacher using lesson plans which paralleled the program. Each of the four programmed learning classes was taught by a teacher acting in a different teaching role. The four experimental teaching conditions were:

- a. The teacher merely monitored the programmed learning session.
- b. The teacher gave no help but completed the program himself.
- c. The teacher answered individual students' questions during the programmed learning session.
- d. The teacher supplemented the program, reviewing basic concepts.

In one set of five classes, no significant differences in student achievement were found. In the other set of five classes, one of the experimental classes achieved at a level significantly higher than any other class. In this class students combined study of the program with supplementation by the teacher. The fact that this type of teacher supplementation produced superior learning in one set of experimental classes and not in the other led to further study of the specific procedures used by the two teachers. In the procedure which was most successful, the teacher reviewed by writing on the blackboard and orally summarizing each concept presented in the program in the order in which it occurred. In the other procedure, the teacher reviewed by means of answering students' questions, utilizing a discussion procedure. The research staff concluded tentatively that it was the systematic nature of the teacher supplementation which produced superior pupil achievement.

Basic Questions to be Answered

The study reported here replicated that phase of the experiment which produced the significant result in the first study described above. In addition, the research staff designed experiments to analyze more precisely

the nature of "systematic" supplementation. The specific questions to be answered were:

- a. Will the differences between systematic supplementation and random supplementation, which were reported in the original study, recur when these two methods of supplementation are structured deliberately?
- b. Will the same differences between systematic and random supplementation occur when different teachers provide the supplementation? (Or, is the difference in supplementation a factor of the teacher's personal characteristics rather than a factor of method?)
- c. Is any method which can be characterized as systematic supplementation equally effective as an accompaniment to programmed learning? (It is possible that the specific method employed by the teacher in the first experiment was the factor which produced the high level of pupil achievement, and the fact that the method was systematic was incidental.)
- d. There are two elements involved in systematic supplementation--thoroughness and sequence. Assuming that systematic supplementation is superior to random supplementation, is it the element of thoroughness (review of all concepts) or the element of sequence (reviewing the concepts in the order in which they are presented in the program) which is critical to pupil achievement? Or must both elements of systematic supplementation be present?
- e. Is it necessary for a human teacher to provide the systematic supplementation, or can this systematic supplementation be supplied by the program itself, with equal results?

Answers to these questions should provide teachers and school administrators with additional information about ways programmed learning materials can best be utilized by teachers under practical classroom conditions.

Brief Description of the Experiment

Three sets of five sixth-grade classes constituted the subjects for this experiment. Each set of five classes was taught by one teacher, especially recruited and trained for this experiment. The cooperating schools were Moses Lake, Quincy and a combination of Ephrata and Soap Lake.

The subject matter was based on the program, Words, A Programed Course in Vocabulary Development, by Susan Meyer Markle, published by Science Research Associates. The approximate amount of time for the experimental teaching period was three weeks. All classes spent 25 minutes each day studying from the programed textbook and writing answers to each frame in booklets prepared for that purpose. Following this 25-minute period, each class received a 12-minute supplementation. In each set of five experimental classes (each set taught by a different teacher), there were the following experimental teaching conditions:

Class A--Systematic supplementation by lecture--The teacher each day wrote on the chalkboard concepts presented in the program, and in the order presented by the program. The teacher commented on these concepts in the 12 minutes allowed for "supplementation." This supplementation was a review for some students and for other students anticipated concepts they had not yet encountered in the program. The teacher paced this supplementation so that all concepts were covered in about the time required for the average student to complete the program. (This was the method used in the original study.)

Class B--Systematic supplementation through a structured recitation--The teacher conducted a recitation using prepared questions covering all the concepts and in the order in which the concepts were presented by the program.

Class C-R--Systematic supplementation by covert response to the program itself--At the end of the 25-minute programed learning period, students turned in their answer booklets and reviewed the frames they completed that day. They were instructed to make covert responses to each frame and to check their mental responses with the correct answers provided in the program. This was considered to be systematic supplementation, but without the direct instruction of a human teacher.

Class X--Random supplementation through recitation--The teacher conducted a recitation using prepared questions which covered all the concepts in the program, but the questions were asked in an order which would scramble the sequence followed in the programed text.

Class Y--Random supplementation through class discussion--After the 25-minute session on the program, the teacher invited pupils to raise questions. The teacher discussed the concepts indicated by the questions. (This procedure was used by one of the classes in the original study, and the comparison of this class and Class A constitutes a replication of the significant experiment in that earlier study.) It was assumed that pupil questions would not cover all concepts, nor would the questions follow the order of sequence in the program.

Results of the Experiments

Size of Class Groups

Students from four Columbia Basin School Districts participated in the experiment. These four districts represented urban, rural farm, and rural nonfarm residences. The distribution of students participating in the experiment may be examined in Table 1. It will be noted that Moses Lake contributed more students than the other districts. This is in part due to the fact that Moses Lake is a larger urban area with greater population.

In the Ephrata-Soap Lake column, the two small numbers represented by Cells A and B represent Soap Lake classes. Soap Lake is a summer resort area with relatively small and relatively stable permanent population. Subsequent analyses took into account both these small numbers and the relatively large groups at Moses Lake.

The Matching Variable--Reading Ability

As in other field experiments conducted at public schools, many variables were encountered which could not be controlled as adequately as in the laboratory. Statistical procedures were used to compensate for the more obvious disadvantages of such a situation.

The research staff examined the program to be used and decided that its content was primarily concerned with the structural analysis of words, vocabulary, and comprehension. (From this conclusion an informal hypothesis was derived.) The research staff hypothesized that the program content was highly correlated with the reading ability of an individual. They concluded, therefore, that reading ability would serve as a matching variable for comparing the fifteen classes who participated in the study.

TABLE 1
NUMBER OF STUDENTS PARTICIPATING IN EXPERIMENT FOR
SCHOOL DISTRICT AND TYPES OF SUPPLEMENTATION

Method of Supplementation	Total	Moses Lake	Quincy	Ephrata - Soap Lake
Lecture - A	72	36	20	16
Structured Recitation - B	74	34	21	19
Random Recitation - X	74	29	23	22
Student Questions - Y	89	36	26	27
Covert Review C-R	90	30	29	31
Total	399	165	119	115

The measurement of this variable was of prime concern to the research staff. It was decided that a recognized standardized reading test would serve this function. Consequently, the Gates Reading Survey Form M-1 was selected.

The selection of this test was based on the following criteria:

- a. No classes had taken this test during the school year in which the experiment took place.
- b. The test measured vocabulary and comprehension in such a manner that the resulting raw scores could be combined to yield a total score.
- c. The test was available in quantity and at a cost that could be borne by the project budget.
- d. The test required no special skill to administer, score, or interpret.
- e. The test could be machine scored by the Counseling Center at Washington State University.
- f. The test was recommended by specialists in reading at Washington State University.

Table 2 indicates that the relation between final test scores and reading test scores, as measured by Gates Reading Survey, was very high. The research staff concluded that the reading scores derived from the Gates Survey could serve as a criterion for equating the groups. The high correlation generates a relatively high level of confidence in this procedure.

An analysis of the experimental groups on the matching variable, reading, is summarized in Table 3. Here the mean scores for the experimental groups are found. The groups present a pattern that is similar and consistent, but there are differences in reading ability as measured by the Gates Survey.

TABLE 2

CORRELATIONS OF GATES READING TESTS WITH FINAL TESTS FOR
SCHOOL DISTRICT AND TYPES OF SUPPLEMENTATION^a

Method of Supplementation	Total	Moses Lake	Quincy	Ephrata - Soap Lake
Total	.73885			
Lecture - A	.70555	.74677	.73655	.62831
Structured Recitation - B	.79262	.81531	.83769	.70865
Random Recitation - X	.70334	.69705	.77802	.64220
Student Questions - Y	.78955	.79909	.86057	.75614
Covert Review C-R	.68244	.50256	.82368	.71741

^aPearson Product Moment Correlation Method

TABLE 3

MEANS ON GATES READING TEST FOR STUDENTS PARTICIPATING IN EXPERIMENT FOR
SCHOOL DISTRICT AND TYPES OF SUPPLEMENTATION

Method of Supplementation	Total	Moses Lake	Quincy	Ephrata - Soap Lake
Total	61.245	56.675	63.193	65.296
Lecture - A	58.208	57.083	61.050	57.188
Structured Recitation - B	63.432	55.200	68.238	69.947
Random Recitation - X	62.730	55.793	65.087	69.409
Student Questions - Y	61.800	55.917	64.269	67.259
Covert Review C-R	60.111	59.666	58.552	62.000

The most notable difference is between the two groups in the Soap Lake school. These mean scores were 57.188 and 69.947. The difference between the two groups may have been associated with interest in music and ability to play in the band. One class included the band students; the other did not. This is not to be taken as a suggestion that students in band are more intelligent. There may have been, however, a high correlation between reading ability, as measured by standardized reading tests, and the ability to read music and/or play a musical instrument.

The Moses Lake schools appear, on the basis of group means, to have the most uniform spread of reading ability. These scores and the total score for Moses Lake are lower than the other areas. This may have been due to the fact that the students participating in the study were located in areas of Moses Lake which included a high proportion of lower socio-economic class families. The data in Table 3 reveals important differences among the groups in reading ability, and the research staff decided that statistical procedures would have to be used to compensate for the contributions made by these differences in reading to the final outcome of the experiment.

The Analysis of Variance

Of prime consideration to the research staff was the effects of teacher supplementation to programmed learning.

When the final data was gathered, the first questions to be answered related to the effectiveness of different methods of supplementing programmed learning. For the first analysis of data, it was assumed that no differences among the groups existed. In other words, it was assumed that the groups were randomly assigned. The staff then asked:

Are the observed differences among the groups resulting from the methods of supplementation? Are the differences related to the experimental teacher and the area in which she teaches? Are the differences due to the interaction of the method of supplementation and the teacher?

The answers to these questions were sought through an analysis of variance. With this analysis, it was possible to examine the contributions being made to the observed differences by the method, the teacher, and the interaction between the method and the teacher.

The data from the analysis of variance is summarized in Table 4. This comparison revealed that in one case in 100 would the observed differences in method be due to chance. In 99 cases in 100, the observed differences are due to some condition other than chance. An examination of the contribution being made to the observed differences by the teacher and/or the area in which she teaches indicates that these differences were not statistically significant. Interaction between method and teacher/area approached the level of statistical significance.

The staff concluded that the analysis of variance supports the general contention that the method of supplementation is the factor contributing a major portion of the observed differences. The staff also concluded that any teacher who is involved in the complex learning environment must interact with the method being used in order that the method become really functional. The fact that this interaction was reduced to a minimum, as revealed by the analysis of variance, gave the staff considerable confidence that experimental controls had been successful in reducing to a minimum teacher personality as a variable. Some interaction between method and teacher would be a reasonable expectation, in the opinion of the research staff, as no interaction suggests a highly mechanical type of presentation.

The Analysis of Covariance

Armed with some confidence that the research design had indeed produced observable differences among methods of supplementation, the staff proceeded with the analysis of covariance. The first step involved the examination of

TABLE 4

ANALYSIS OF VARIANCE FINAL TEST ANALYZED BY METHOD VARIABLE,
TEACHER VARIABLE AND INTERACTION BETWEEN METHOD
AND TEACHER VARIABLE^a

Source of Variation	Sum of Squares	df	Mean Squares	Observed F Ratio	F Ratio Required for .05 Level Significance	F Ratio Required for .01 Level Significance
Method	3,481.754	2	1,740.877	9.882**	3.02	4.66
Teacher	992.178	4	248.045	1.408	2.39	3.36
Interaction	2,745.155	8	343.144	1.948 ^b	1.96	2.55
Individual	1,699,690.770	384	176.166			

^aThis Analysis developed from the short method recommended by Snedecor, p. 386.

^bThis difference approaches significance at the .05 level.

*Significant at .05 level.

**Significant at .01 level.

all scores combined without regard to teacher or area taught. This approach seemed justified by the variance analysis discussed earlier.

In any field situation, the control of many important variables is difficult if not impossible. It, therefore, becomes necessary to use other methods to overcome some of the disadvantages of this lack of control. In order to do this, the experimental groups must be equated in such a way that observed differences among them are not due to variables which may have a great deal of influence over the results being sought. The present experimental design sought to reduce important differences in groups by comparing their scores on reading tests and using these scores as weights to equate the groups. Some groups would have their final test scores reduced; other groups would find their final test scores increased. The amount and distribution of the weights is determined by the results on the final test and the relative scores on the reading test--the matching variable.

Final test results are presented in Table 5. An examination of this information reveals that great variation occurred among the groups in mean scores on the final tests. The pattern that these differences showed was of interest, but of far greater concern was the question of differences. It was of vital importance to know with what confidence we could state that differences between one method and another were due to some factor other than chance fluctuation in data. In addition, it was of vital concern that we know how much differences in reading ability were contributing to these differences in final test scores.

The solution to the last problem stated above was obtained through the analysis of covariance. This statistical technique allows the researcher to parcel out, among experimental groups, the influences of a known important variable. Thus, it was possible to weigh these final test scores on the basis of reading test scores. These new scores are said to be adjusted for differences in reading scores.

TABLE 5

MEANS ON FINAL TESTS FOR STUDENTS PARTICIPATING IN THE EXPERIMENT FOR
SCHOOL DISTRICT AND TYPES OF SUPPLEMENTATION

Method of Supplementation	Total	Moses Lake	Quincy	Ephrata - Soap Lake
Total	194.639	193.679	184.672	206.330
Lecture - A	193.542	203.417	195.550	168.813
Structured Recitation - B	216.635	204.647	217.095	237.579
Random Recitation - X	203.622	192.103	187.609	235.545
Student Questions - Y	188.900	181.333	184.000	203.704
Covert Review C-R	175.722	185.900	151.966	188.097

The adjusted mean scores for the final test are presented in Table 6. A comparison of Table 5 with Table 6 reveals the extent to which the analysis of covariance added or subtracted in order to bring about an adjustment. These adjusted scores can be compared with confidence that the differences between any two are due, for the most part, to experimental variables and not to intervening variables or characteristics residual in the experimental groups.

Adjusted Differences Among Groups in All Three Schools

Using these adjusted mean scores, it is possible to examine differences between one method of supplementation and another. Again the comparison is made by determining the degree that an observed difference could have occurred by something other than chance. Such an expression is referred to here as level of statistical significance.

Table 7 summarizes the differences between the adjusted mean scores. Reading across the top, one sees the methods of supplementation, and by reading down any one of these columns, it is possible to find the amount that the method differs from any other method. For example, method A (top row of the table) differs from method B (column 1 under A) by -5.845. This should be interpreted to mean that when method A for all groups is compared with method B for all groups, the resulting differences (A-B) favors method B. Similarly when comparing method X with method Y, a difference of 11.651 is found. This difference favors method X.

Asterisks were used to interpret the statistical significance of differences. For example, the difference between method A and method Y is 16.501. It is marked with one asterisk. The single asterisk indicates that in 95 cases in 100, this difference would have been the result of some factor other than chance. This difference, then, is due to some real difference between methods, not merely to chance fluctuation in data.

TABLE 6

MEANS ON FINAL TEST ADJUSTED FOR DIFFERENCES IN READING LEVEL
AS MEASURED BY GATES READING TEST FOR SCHOOL DISTRICT
AND TYPES OF SUPPLEMENTATION

Method of Supplementation	Total	Moses Lake	Quincy	Ephrata - Soap Lake
Lecture - A	203.569	202.068	202.964	198.136
Structured Recitation - B	209.414	209.525	199.642	220.758
Random Recitation - X	198.719	195.020	181.057	220.670
Student Questions - Y	187.068	183.840	180.278	196.605
Covert Review C-R	179.466	176.009	168.021	200.017

TABLE 7
ANALYSIS OF COVARIANCE DIFFERENCES BETWEEN MEANS ON FINAL TEST
ADJUSTED FOR DIFFERENCES IN READING LEVEL
FOR TYPES OF SUPPLEMENTATION
ALL SCORES

Method of Supplementation	Lecture A	Structured Recitation B	Random Recitation X	Student Questions Y	Covert Review C-R
Lecture - A ^a	---				
Structured Recitation - B ^a	-5.845 ^b	---			
Random Recitation - X ^a	4.850	10.695	---		
Student Questions - Y ^a	16.501*	22.346**	11.651	---	
Covert Review C-R ^a	24.103**	29.948**	19.253**	7.602	---

^aThese Differences obtained by subtracting from Means across the top of the table.

^bDifference favors Type B.

*Significant at .05 level.

**Significant at .01 level.

Table 7 supports the conclusion of the earlier study by Wriggle and Hite. Systematic and orderly supplementation to programmed learning by means of a teacher providing a lecture (A) was superior to a random method of supplementation which was characterized by a discussion of questions raised by students (Y). Another systematic supplementation method which was characterized by a structured recitation (B) was also superior to the random, or discussion, method of supplementation (Y). The level of significance of the difference of method B over method Y was greater than the level of significance for the difference of method A over Y.

Even more significant differences appeared, however, when the covert response method was compared to other methods. In this covert response method, the pupils supplemented their programmed learning by reviewing their work by simply making mental responses to the same frames they had previously answered by writing. This method was significantly inferior to both systematic supplementation methods. The covert response method of supplementation was also significantly less effective than the method which included only one element of systematic supplementation. This was the method in which all concepts presented by the program were covered in a structured recitation, but the concepts were deliberately presented in a different order from the order followed in the program.

The research staff noted that except for the random, or discussion method, there were significant differences among methods of supplementation which utilized the teacher in an active role and the method in which the teacher was not actively engaged (the covert response method). These differences indicated that methods involving the teacher were superior.

Thus, the research staff concludes that these observed differences indicate that:

- 1) Systematic supplementation increases differences over random supplementation when accompanied by participation between the teacher and the students.
- 2) Systematic supplementation by the program itself is not as satisfactory as the variation of supplementation which involves participation and/or a restatement of concepts in different words by the human teacher.
- 3) Presentation of the concepts in the same order as presented in the program does not appear to produce differences that are significant; therefore, orderly presentation is not as important as interaction through participation.
- 4) Thorough, orderly, sequential, systematic supplementation is superior to a situation in which students ask questions without regard to thoroughness, order, or sequence even when interaction through participation is present.

Moses Lake

In order to provide an answer to one of the questions posed by the research staff in the original proposal, the analysis of covariance was extended to include separate analyses of each of the three separate experimental situations.

The pattern for Moses Lake, shown in Table 8, tends to follow the pattern for all scores. In this experiment, structured and orderly supplementation (methods A and B) appears to be better with the human teacher than with the program itself (method C-R). If interaction through participation is added, a highly significant difference appears. Structured, orderly, and thorough interaction through participation (B) is superior to mere interaction through

TABLE 8

ANALYSIS OF COVARIANCE DIFFERENCES BETWEEN MEANS ON FINAL TEST
ADJUSTED FOR DIFFERENCES IN READING LEVEL
FOR TYPES OF SUPPLEMENTATION
MOSES LAKE

Method of Supplementation	Lecture A	Structured Recitation B	Random Recitation X	Student Questions Y	Covert Review C-R
Lecture - A ^a	---				
Structured Recitation - B ^a	-7.457 ^b	---			
Random Recitation - X ^a	7.048	14.505	---		
Student Questions - Y ^a	18.228	25.685 [*]	11.180	---	
Covert Review C-R ^a	26.059 [*]	33.516 ^{**}	19.011	7.831	---

^aThese Differences obtained by subtracting from Means across the top of the table.

^bDifference favors B.

^{*}Significant at .05 level.

^{**}Significant at .01 level.

participation which lacks the orientation given through pre-planning (Y). Again, the difference between the structured lecture which lacks participation (A) and the structured recitation which has participation (B) is not significant statistically but favors participation.

Quincy

The efforts of the human teacher as an integral part of the orderly and thorough presentation of concepts is underscored by Table 9. In this experiment, the supplemental review furnished by the program alone (C-R) is clearly inferior to that supplementation which is systematic (A) and equally inferior when participation (B) is considered. The difference between completely systematic (A) and completely random (Y) approaches a point at which statistical significance is almost reached. This, too, supports the results reported for the analysis of all scores.

Ephrata-Soap Lake

The data for this experiment, shown in Table 10, shows no differences that reach the level of statistical significance. There are some inconsistent directions of these differences. The differences between Lecture and Structured Recitation (A-B) favor B to a level that is almost significant. The difference between Lecture and Random Recitation (A-X) favors X to a level that is almost significant. These directions tend to support the overall findings that participation is an important ingredient in supplementation to programmed learning.

However, when the data regarding supplementation by the program alone is examined, it is found that the direction favors program review (C-R) over Lecture (A), and program review (C-R) over Student Questions (Y).

When these directions are compared with the findings of the other two experiments and with the total scores, they suggest that the experimental teacher

TABLE 9

ANALYSIS OF COVARIANCE DIFFERENCES BETWEEN MEANS ON FINAL TEST
ADJUSTED FOR DIFFERENCES IN READING LEVEL
FOR TYPES OF SUPPLEMENTATION
QUINCY

Method of Supplementation	Lecture A	Structured Recitation B	Random Recitation X	Student Questions Y	Covert Review C-R
Lecture - A ^a	---				
Structured Recitation - B ^a	3.322	---			
Random Recitation - X ^a	21.907	18.585	---		
Student Questions - Y ^a	22.686 ^b	19.364	.779	---	
Covert Review C-R ^a	34.943 ^{**}	31.621 ^{**}	13.036	12.257	---

^aThese Differences obtained by subtracting from Means across the top of the table.

^bApproaches significance at .05 level.

*Significant at .05 level.

**Significant at .01 level.

TABLE 10

ANALYSIS OF COVARIANCE DIFFERENCES BETWEEN MEANS ON FINAL TEST
ADJUSTED FOR DIFFERENCES IN READING LEVEL
FOR TYPES OF SUPPLEMENTATION
EPHRATA - SCAP LAKE

Method of Supplementation	Lecture A	Structured Recitation B	Random Recitation X	Student Questions Y	Covert Review C-R
Lecture - A ^a	---				
Structured Recitation - B ^a	-22.622 ^b	---			
Random Recitation - X ^a	-22.534 ^c	.088	---		
Student Questions - Y ^a	1.531	24.153 ^e	24.065 ^e	---	
Covert Review C-R ^a	-1.881 ^d	20.741	20.653	-3.412 ^d	---

^aThese Differences obtained by subtracting from Means across the top of the table.

^bDifference favors B.

^cDifference favors X.

^dDifference favors C-R.

^eApproaches significance at .05 level.

* Significant at .05 level.

** Significant at .01 level.

in this situation may have had difficulty with the Lecture method. Observation in the classroom during the experiment tends to confirm that this may, indeed, have been the case. The direction so heavily weighted in favor of Structured Recitation (B) and the small difference between Structured Recitation and Random Recitation (B-X) suggest that there may have been interaction between the teacher and the methods to a significant degree.

This finding may partially explain the F ratio for the analysis of variance in Table 4 which indicates that interaction between "method" and "teacher" is approaching the level of statistical significance.

The Delayed Posttest

Approximately one month after the completion of the experimental teaching, a delayed posttest was administered to the experimental classes. This test was identical to the final test given at the end of the experimental teaching phase.

Table 11 contains the mean and standard deviation scores for all experimental classes. A comparison of these scores from Table 11, with the data presented in Table 5, gives some indication as to the change in scores after approximately a one month elapse of time.

The scores in Table 11 can be read as very rough retention scores. Caution must be exercised in generalizing from them, however, since it is known that some students continued to work in the program beyond the experimental period. It is further known that some teachers worked with entire classes in the same area as that covered by the program.

The general pattern appears to remain approximately the same. The comparison of Means from Tables 5 and 11 reveals that the same approximated relationships existed among groups after the delayed posttest as held after the final test. The research staff interpreted this to mean that nothing which was found as a result of the posttest would cause a reappraisal of the findings based on the adjusted mean scores presented in Table 6.

TABLE 11
MEANS AND STANDARD DEVIATIONS ON DELAYED POSTTEST FOR
SCHOOL DISTRICT AND TYPES OF SUPPLEMENTATION

		Total	Moses Lake	Quincy	Ephrata - Soap Lake
Total	\bar{X}	180.770	176.316	179.230	188.300
	σ	66.933	66.875	67.747	66.138
Lecture A	\bar{X}	173.820	181.258	181.105	153.937
	σ	65.873	70.179	69.131	52.270
Structured Recitation B	\bar{X}	206.103	192.000	219.400*	214.833
	σ	68.920	77.315	66.057	54.839
Random Recitation X	\bar{X}	181.375	158.500	182.318	209.545
	σ	62.778	55.551	66.082	58.825
Student Questions Y	\bar{X}	180.115	174.917	171.200	195.885
	σ	69.793	71.372	64.026	72.650
Covert Review C-R	\bar{X}	165.964	175.500	153.074*	169.194
	σ	62.202	53.911	62.757	68.041

* Gain from Final Test.

Two interesting scores were found in the data presented in Table 11. The Structured Recitation (B) experimental class from Quincy apparently made a group gain. Their mean score on the final test was 217.095. When this group was tested one month later, its mean score was 219.400. The Covert Review (C-R) experimental class from Quincy also apparently made a group gain. Their final test mean score was 151.966, and their delayed posttest mean score was 153.074.

It is possible to offer several acceptable explanations for these occurrences. First, some of these students continued work in the program beyond the experimental teaching phase. The subject matter of the curriculum contained many aspects which could have acted as reinforcing agents for the concepts presented by the program. These groups were highly motivated and developed a "coaster" effect which contained self-reinforcing elements in it.

As interesting as these explanations are, they do not explain why these two particular classes posted gain scores. All of the factors mentioned were known to be operating in at least some of the other experimental classes. The classroom teachers in several of the experimental classes attempted to take advantage of the experiment by continuing to work with the students in the same area as the program. The experimental teachers did not appear to handle these classes in a way that could account for this phenomena. The classroom teachers do not appear to have added, to their post-experimental teaching, factors different from those added by several other classroom teachers.

An examination of the scores of these two groups from Tables 2 and 3 yields interesting information. These two groups produced two of the three highest correlations reported. The Structured Recitation (B) groups had one of the highest mean scores on the Gates Reading Survey, and the Covert Review (C-R) group had one of the lowest mean scores.

The research staff can find nothing, beyond that which has already been reported, to offer as an explanation of this observed phenomena. Table 11 data suggests a rather high level of retention of the material taught by all methods. This further confounds attempts to interpret the two Quincy scores.

Conclusions

- 1) The human teacher is an important part of the learning environment which supplements the program.
- 2) There are specific things that the human teacher can do to add measurably to the learning that accompanies a program.
- 3) The supplementation to programmed learning, which produces the greatest amount of learning, appears to be that in which the human teacher presents the concepts from the program.
- 4) The order and manner of presentation of these concepts does not appear to be as important as that the teacher feel comfortable with the particular technique used to supplement the program.
- 5) The more systematic presentation appears to increase learning.
- 6) Some interaction of teacher and student through overt participation would appear to produce superior results.

Limitations

These conclusions should be interpreted with the following limitations in mind:

- 1) This study was with one specialized phase of the curriculum. Generalizations to other subject areas should be accompanied with caution.

- 2) The experimental classes were composed of sixth grade students.

Generalizations to other sixth grade students should be done only after careful study of the sample used in this study.

Generalizations to other grade levels should be accompanied with caution. The experimental methods applied here may act as negative reinforcers at higher levels.

- 3) Three special teachers were used. Generalizations to all teachers should be accompanied with caution. The teacher must be prepared to share the teaching role with the program. The teacher needs to know something of program theory and the learning theory upon which it is based. The teacher must be prepared to plan in detail and state objectives clearly.

THE EFFECTIVENESS OF DIFFERENT FORMS OF SUPPLEMENTATION
AS ADJUNCTS TO PROGRAMED LEARNING
(A Follow-up Study)

Abstract

The major question to be answered in the study was whether or not programed learning could be supplemented effectively by the classroom teacher. Because a program supplies the material to be learned, guides the learner step by step through this information, and informs the learner as to the correctness of each of his responses, some educators have questioned the traditional role of the classroom teacher. What exactly can the teacher do to supplement a program to increase student achievement in the subject matter "taught" by the program?

A study reported by Wriggle and Hite in 1962¹ concluded tentatively that teachers might supplement programs and increase student achievement, providing this supplementation was systematic. Systematic supplementation was characterized by covering all major concepts included within a program, and covering these concepts in the same order presented by the program.

In this follow-up study, five different methods for supplementing the program were devised and evaluated. Each method was applied at the conclusion of a 25-minute period, during which students wrote answers to frames in a program. Each of the five methods of supplementation was conducted during a 12-minute period immediately following the student sessions with the programs. The five methods were:

Type A--Systematic supplementation to the program was provided by the teacher who wrote concepts on the chalkboard and gave a brief explanatory

¹Larry Wriggle and Herbert Hite, The Amount and Nature of Teacher Help Necessary for Optimum Achievement Through Use of Programed Learning Devices, Research Report No. 05-01, State Superintendent of Public Instruction, Olympia, Washington, 1962.

lecture. This method was the specific technique of supplementation found to be effective in the earlier study.

Type B--Systematic supplementation was provided through a structured recitation in which the teacher conducted a question and answer session over each concept in the program and in the order presented by the program.

Type X--The teacher conducted a recitation similar to method described above as Type B, except that the order in which concepts was covered was different from the order in which the program presents the concepts.

Type Y--This was a method of supplementation in which the teacher solicited questions from the students and discussed those questions only. Not all concepts could be covered through this method, and the order in which concepts were covered was not the same order as presented in the program.

Type C-R--In this method, the students were asked to review the frames they had completed that day by making mental responses to the questions to which they had previously written responses. This method was systematic, but it eliminated the human teacher as an active agent in this supplementation.

To reduce the effect of the teacher as a variable, three different teachers were hired specifically for the project, and trained to conduct each of the five types of supplementation. Each of the three teachers taught five experimental classes using a different method of supplementation with each class. The three groups were located in Moses Lake, Quincy, Ephrata-Soap Lake. The research assumed that by comparing the results obtained by each of the three teachers, it would be possible to generalize with greater confidence than if there had been no attempt to control the teacher variable.

Sixth-grade students were the subjects for the experiment. The program used was titled, "Words", by Susan M. Markle, and the subject matter of the program was structure and analysis of words.

Figure 5 shows the design of the experiment.

The 15 sixth-grade classes first took a standardized reading test, and the scores from this test were used to judge the equivalence of the different classes. The students also were given a pretest over the subject matter to be covered by the program. The classes did differ to a significant degree in reading ability.

Each student was allowed to work at his own rate during the daily 25-minute practice period. When each student completed the program, he spent an additional period in review and then took a final test over the material covered in the program. Through an analysis of covariance, the final test scores of each of the experimental classes were adjusted on the basis of the scores on the tests of reading skills. Another test over the programmed material was administered after an interval of approximately one month to compare the classes on the amount remembered from the program.

The results of the reading test used as a matching variable, the final test results and the delayed posttest are shown in Figures 1, 2, 3, and 4. Figure 6 shows the means, as adjusted in terms of reading skills, and dispersions of scores on each of the five experimental methods which were obtained when the classes at all three school district centers were combined.

Results

1. The tentative conclusion from the study by Wriggle and Hite was confirmed. Systematic supplementation (characterized by covering all concepts of the program and in the same order as presented by the program) was superior to supplementation by more random procedures. This result is shown by the differences among methods A and B and method Y.

2. Even more significant were the differences between the method which included systematic supplementation without direct guidance by the teacher, and certain of the other methods. The systematic methods directed by the teacher, A and B, were significantly superior to the covert-response method (C-R). The method of supplementation conducted by the teacher which included only one of the two characteristics of systematic supplementation (method X) was also superior to the covert-response method.
3. A comparison of the results in each of the three districts showed some differences in the general patterns of results. This was particularly true at Ephrata-Soap Lake. An analysis of variance by the research staff compared the relative effects of the different methods, the different teachers, and the interaction between teacher and methods. This analysis showed that the method used was the significant variable in accounting for differences among the groups. Interaction between teacher and method, however, approached the level of significance as a factor associated with differences in group scores. Apparently, the teacher's preference as to method of supplementation was a factor.
4. A comparison of the pretests on the subject matter of the program, and a portion of the final test which included the same test items, showed that all classes learned a significant amount from the program, regardless of the supplementation method which was used. Of the 15 classes, all but three more than doubled their scores on these test items.
5. The results of the delayed posttest indicated that students have a high degree of retention on this program. Results from the delayed posttest showed the same tendencies as those on the final tests.

Conclusion

Learning from programmed devices tends to be increased to a significant degree when the classroom teacher supplements the program with short reviews, in sequence, of each concept presented by the program. Different methods which utilize the principles of sequence and thoroughness appear to be equally effective. Because the variable of method and the variable of the teacher interact, the staff infers that the preferences of the individual teacher in terms of method may be a significant factor in this supplementation.

The role of the human teacher appears to be critical to learning from programs. Supplementation in which the teacher does not play an active role, even if this supplementation meets the standards of thoroughness and orderliness, is not nearly as effective as supplementation by the human teacher.

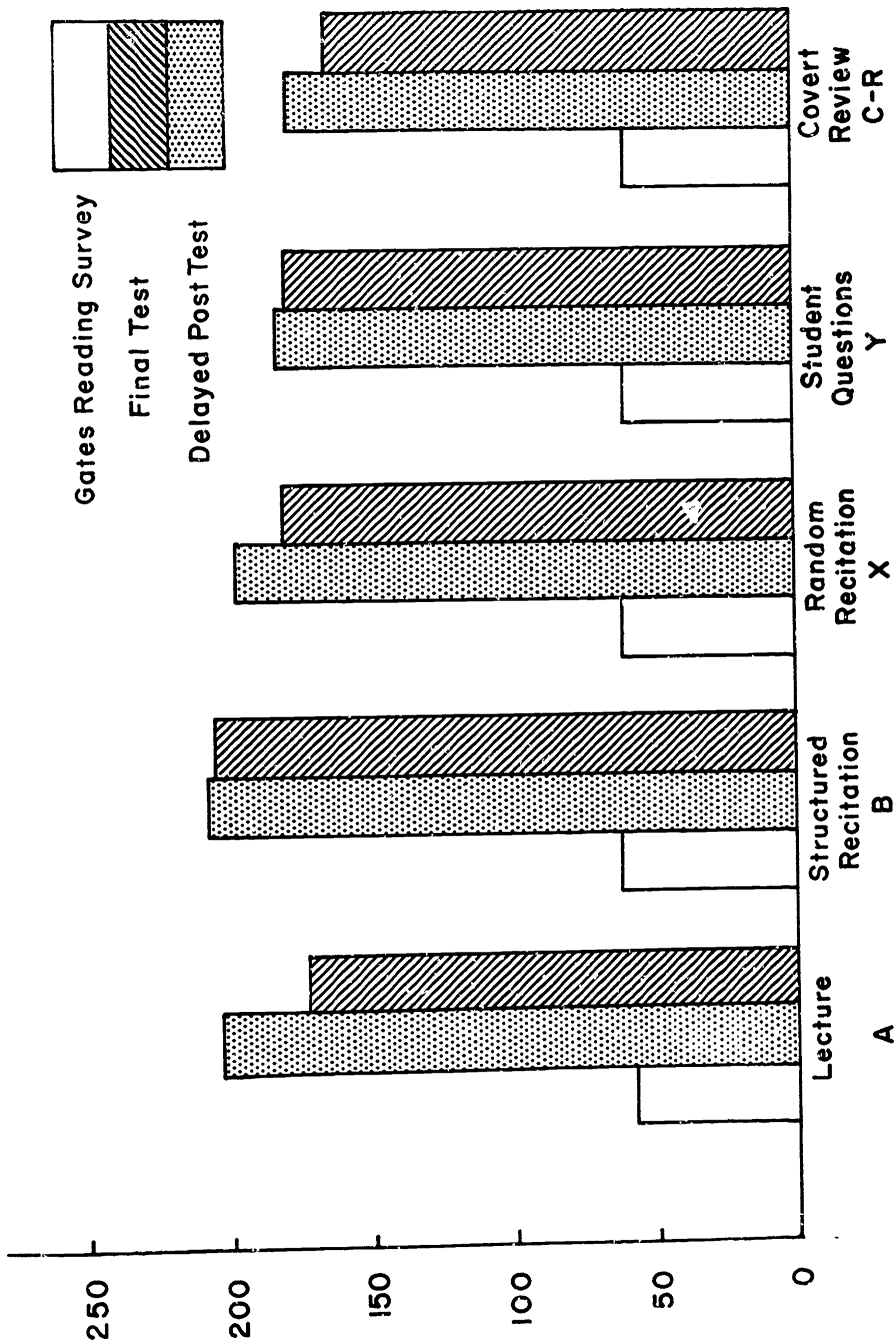


Figure 1 Mean Scores on Gates Reading Survey, Adjusted Final Test and Delayed Post-Test All Scores

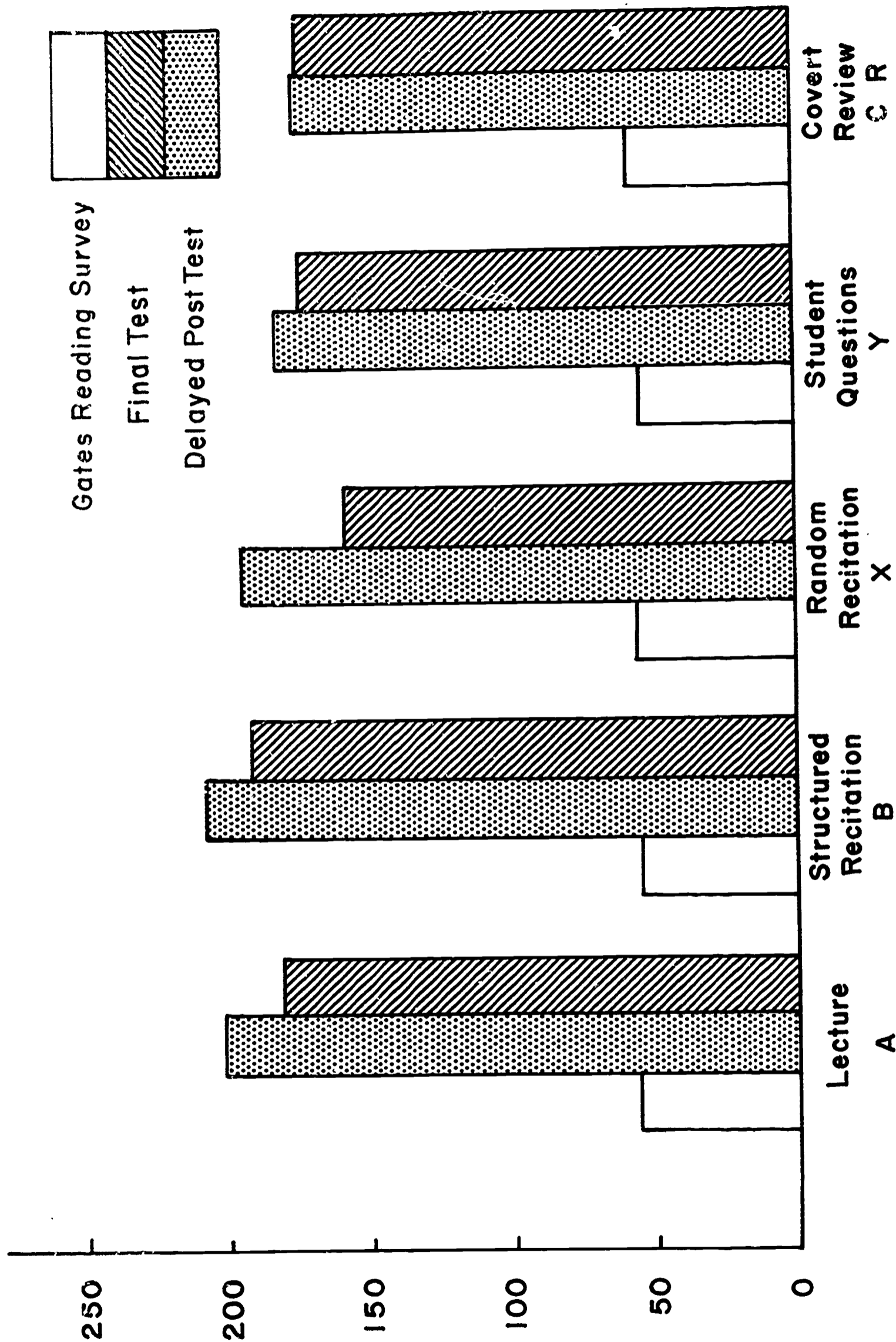


Figure 2 Mean Scores on Gates Reading Survey, Adjusted Final Test
and Delayed Post-Test Moses Lake

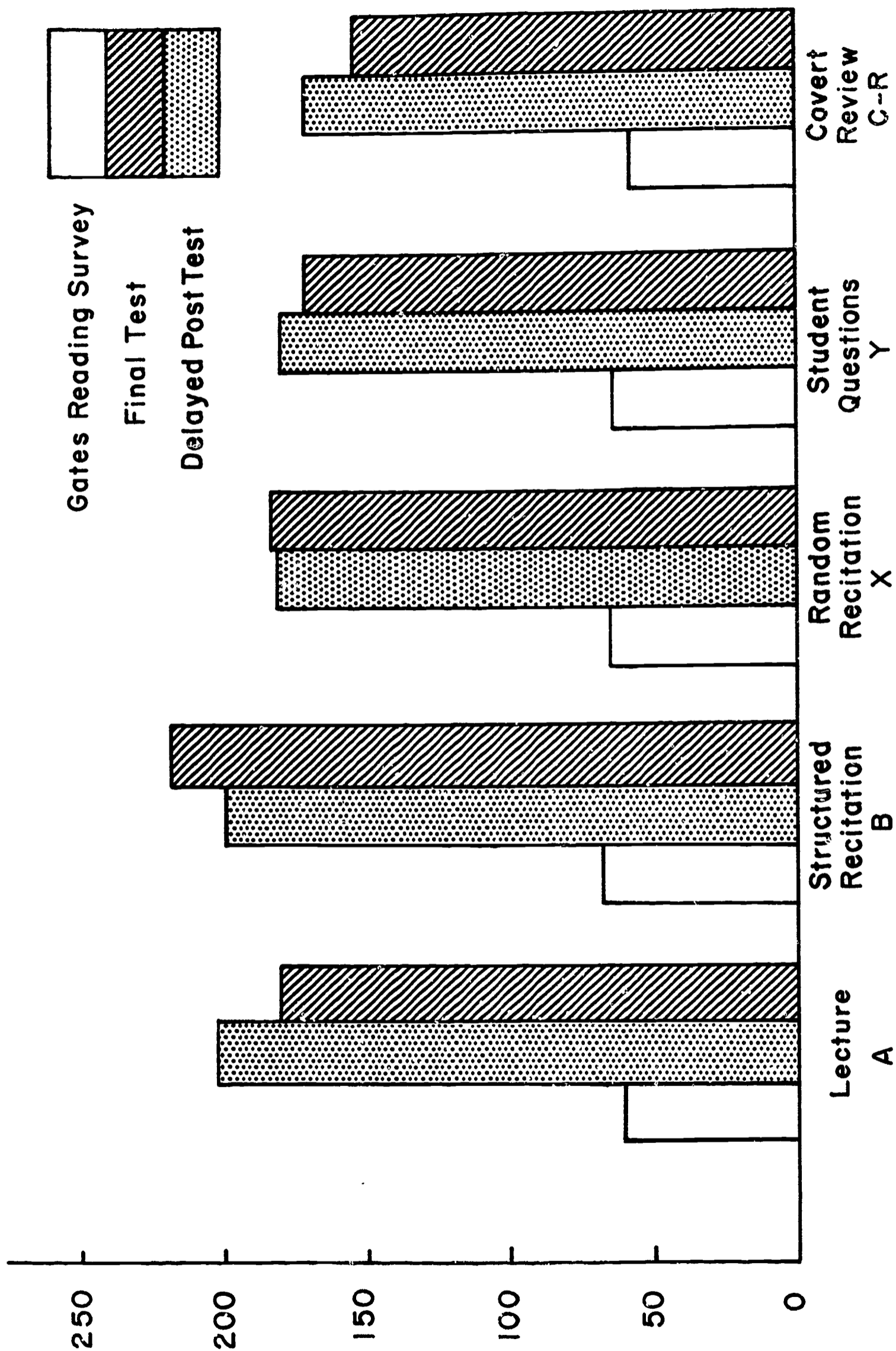


Figure 3 Mean Scores on Gates Reading Survey, Adjusted Final Test and Delayed Post-Test Quincy

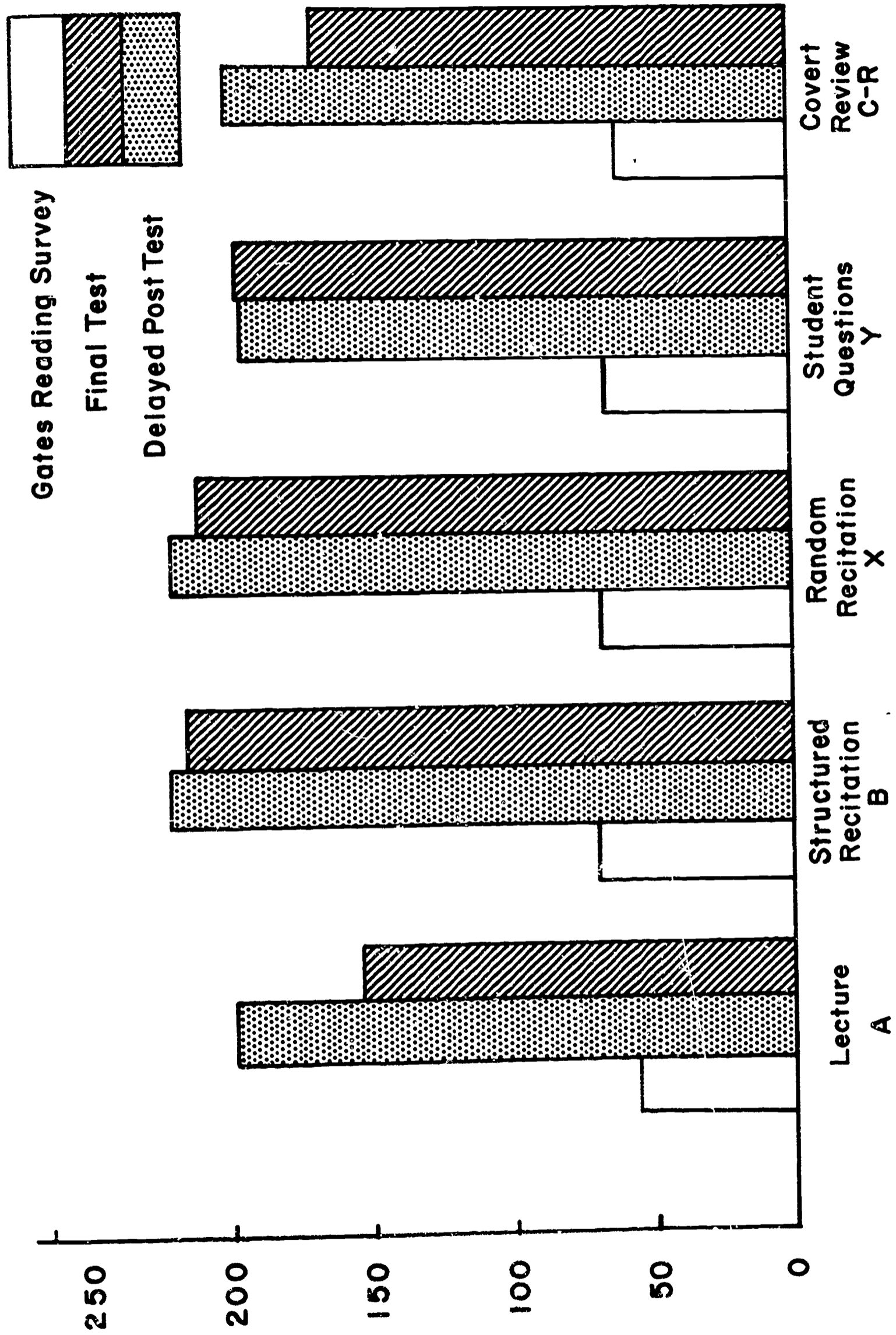


Figure 4 Mean Scores on Gates Reading Survey, Adjusted Final Test and Delayed Post Test Soap Lake

Figure 5 Experimental Design of the Study

Teacher A -- School X

1	2	3	4	5
---	---	---	---	---

Teacher B -- School Y

1	2	3	4	5
---	---	---	---	---

Teacher C -- School Z

1	2	3	4	5
---	---	---	---	---

Class 1 Systematic Supplementation -- A

(teacher reviews)

2 Systematic Supplementation -- B

(recitation)

3 Systematic Supplementation -- C

(programed)

4 Random Supplementation -- X

(recitation)

5 Random Supplementation -- Y

(discussion)

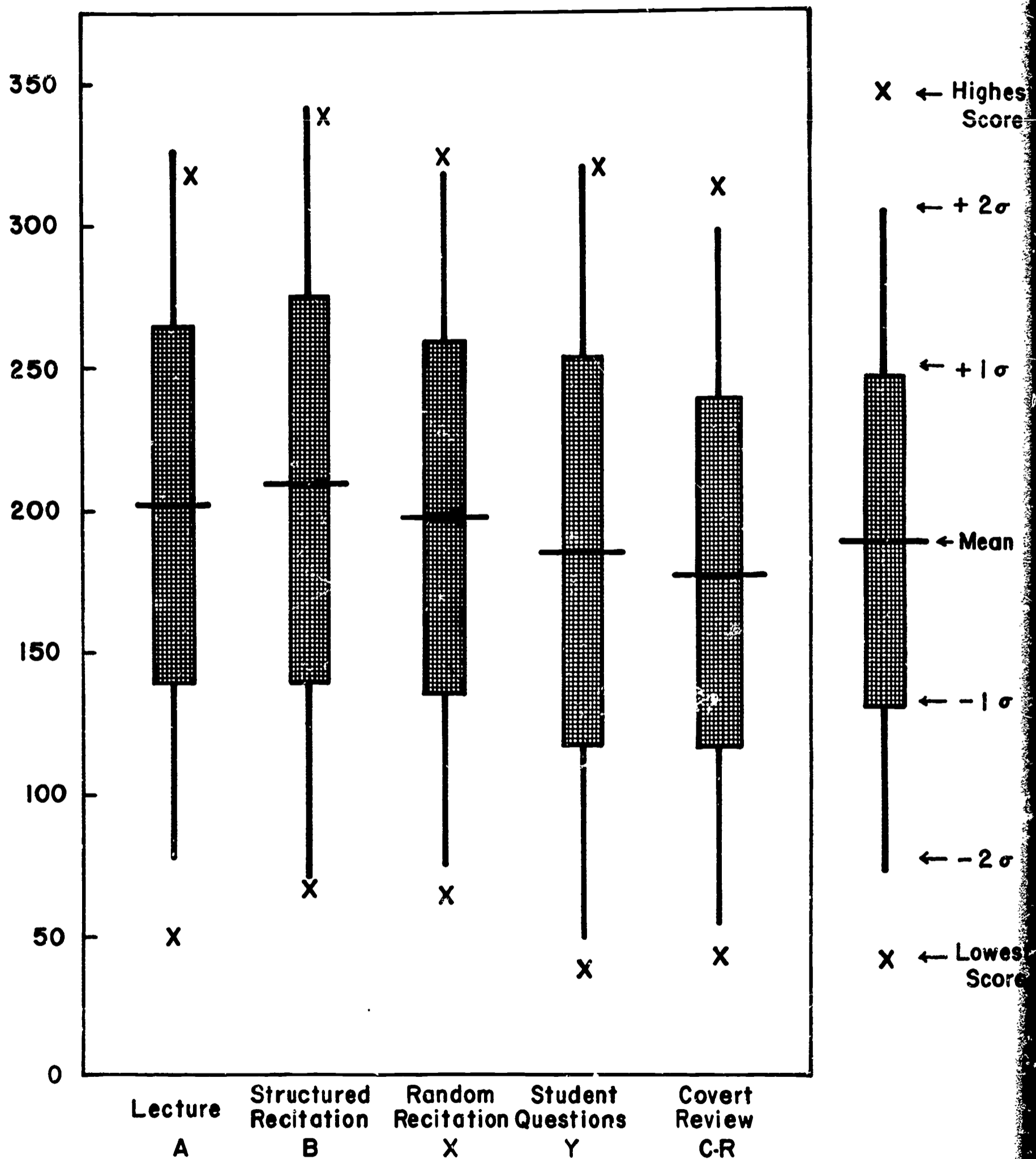


Figure 6 Total Adjusted Final Test Mean Scores and Standard Deviations for Types of Supplementation

APPENDIX 1

RELATED QUESTIONS

Related Questions

Student Gains

The experiment reported here was not designed to measure the gains students made from studying a program. The experiment was concerned with methods that a classroom teacher could employ to supplement a programmed instruction curriculum.

Information relative to student gains was gathered, however, and this data is discussed in this appendix.

The research staff was quite aware of its responsibility to the students when the design of the present experiment was developed. In selecting the material to be presented and the techniques with which it was to be presented, we were continually aware of the moral and ethical obligation placed on us by the invitation to conduct field research. Such research should not impede student progress, nor should it interfere with learning essential to subject matter.

In analyzing the data from the experiment, it occurred to the research staff that one of the most significant questions which faces district school boards, district superintendents, building principals, and classroom teachers relates to the implication of field research in the classroom. Does field research in a public school classroom impede student progress or interfere with learning?

The information presented in Tables 12 and 13 appears to give evidence that supports a rather confident "no" to the question posed above. If we assume that the subject matter and the content of the program Words was a worthy part of the public school curriculum, then it is possible to indicate that all experimental classes learned a great deal in a relatively short time

TABLE 12

MEANS AND STANDARD DEVIATIONS ON PRETEST BEFORE EXPERIMENT FOR
SCHOOL DISTRICT AND TYPES OF SUPPLEMENTATION

		Total	Moses Lake	Quincy	Ephrata - Soap Lake
Total	\bar{X}	32.048	30.201	32.881	33.826
	σ	9.719	9.076	10.018	9.922
Lecture A	\bar{X}	32.472	30.416	34.100	35.063
	σ	9.177	9.050	8.747	9.476
Structured Recitation E	\bar{X}	33.959	30.454	35.667	38.158
	σ	9.620	8.163	9.687	10.144
Random Recitation X	\bar{X}	31.703	31.586	30.609	33.000
	σ	8.051	7.524	10.347	5.879
Student Questions Y	\bar{X}	32.157	29.139	35.077	33.370
	σ	10.804	9.920	9.830	12.125
Covert Response C-R	\bar{X}	30.315	29.600	29.750	31.516
	σ	10.224	10.647	10.416	9.855

TABLE 13

MEANS AND STANDARD DEVIATIONS ON REPEAT OF PRETEST
AFTER EXPERIMENT FOR SCHOOL DISTRICT AND
TYPES OF SUPPLEMENTATION

		Total	Moses Lake	Quincy	Ephrata - Soap Lake
Total	\bar{X}	70.200	71.211	64.765	74.365
	σ	28.241	28.829	28.434	26.493
Lecture A	\bar{X}	70.562	75.861	69.800	60.375
	σ	28.146	29.465	28.189	24.079
Structured Recitation B	\bar{X}	79.365	75.000	80.142	86.316
	σ	27.224	30.777	25.339	21.636
Random Recitation X	\bar{X}	73.608	72.172	63.826	85.727
	σ	26.949	26.644	27.091	23.403
Student Questions Y	\bar{X}	68.910	67.694	65.192	74.111
	σ	28.228	29.878	28.037	26.369
Covert Review C-R	\bar{X}	60.844	65.066	50.517	66.419
	σ	27.814	27.116	26.908	27.488

from the experiment. An examination of Tables 12 and 13 reveals that in 12 of the 15 experimental classes, the groups increased their mean scores by at least 100% during the experiment. In some cases, the increase was greater. In the remaining three, the increases were less spectacular but large, nevertheless. No experimental class failed to increase its mean scores. An examination of the individual student scores revealed that no student failed to post an increase in score. Some students who obtained lower scores prior to the experiment made spectacular gains. One student posted a pretest score of 8 points and a score of 34 points after the experiment. Another student's score was 19 to 70. A third increased from 11 points to 33 points. For these poorer students, such gains may be more meaningful than similar increases for students who posted higher pretest scores.

From the data gathered for the experiment, the research staff concludes, with a rather high level of confidence, that:

- 1) Experimentation did not interfere with learning in the experimental classes.
- 2) Experimentation did not impede student progress toward desirable educational goals--in this case, better mastery of their own language.

Teacher-Time

The experiment reported here was not designed to explore the use of teacher-time except through supplementation. One significant aspect of this experiment has not been discussed in the early parts of this report. This question relates to the use of teacher-time released through the utilization of programmed instruction. The data presented in the experiment supports the contention that the program alone will teach significant amounts of information.

The Covert Review (C-R) experimental classes learned a great deal from the program in all three experiments. These classes received no assistance from the teacher.

The implications of this are varied and worthy of consideration. The study points to the fact that students can learn without the aid of the human teachers. The study also indicates that significant increases in learning can be brought about by certain very specific activities on the part of the classroom teacher. This still leaves some pertinent questions:

- 1) Should the teacher-time released in this manner be used to supplement the program, thereby, increasing the learning already occurring?
- 2) Should the gain in teacher-time be used to accomplish other tasks of a desirable educational nature?
- 3) Should the teacher-time gained by using a program be used to accomplish routine clerical tasks associated with the day-to-day operation of the school?

Such questions are not answered by this research. The research staff does not feel qualified to answer these questions. Such questions are clearly administrative and policy questions that will have to be decided by school boards and district administrative personnel.

The research staff feels that this and other research gives these questions a timeliness that cannot long be ignored. A consideration of these questions should accompany the consideration of the addition of programmed instruction to the curriculum of any school system.

APPENDIX 2

SAMPLE FRAMES FROM THE PROGRAM

CHAPTER ONE

Part A

Locate the foldout panel on the inside back cover of this book.

-
- | | |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. roots | 1. Read the panel. It tells you what this chapter is about. There are three kinds of parts in many words. They are called <u>prefixes</u> , <u>suffixes</u> , and _____s. |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
-
- | | |
|---------|---------------------------------------------------------------------------------------|
| 2. root | 2. The panel says that a meaningful unit called a <u>suffix</u> is put after a _____. |
|---------|---------------------------------------------------------------------------------------|
-
- | | |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3. words | 3. A part of a word can be as small as one letter. The letter -s at the end of a word often means "more than one." The word that means "more than one" is WORD_. |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
-
- | | |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4. after | 4. WORD is a <u>root</u> . When you add -s you build a new word: WORDS. Find the answer to this one on the panel: The part -s must be a <u>suffix</u> , because it goes _____ the <u>root</u> WORD. (where?) |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
-
- | | |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5. dog
s | 5. You knew some parts of words long before you knew that these parts had names.
For instance, the word DOGS has two parts:
a) the <u>root</u> ____; and
b) the <u>suffix</u> ____, which means "more than one." |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
-
- | | |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6. suffix | 6. The part -s is familiar. You know that you add it to a word to make the word plural.
THING means "one object"; THINGS means "more than one object." We put the -s after the <u>root</u> , so we call this -s a <u>s f f x</u> . |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
-
- | | |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7. boxes | 7. After some words that end in certain letters, such as X or CH, we use the suffix -ES instead of -S. This is not new to you. You said the words correctly long before you heard of spelling rules. The word that means "more than one box" is BOX__. |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
-

-
8. tax 8. The part -ES is familiar. You know that the word TAXES has two parts:

es

the root __ __, and
the suffix __ __, which means "more than one."

9. two 9. The parts we are talking about add meanings to words. They are not the same as letters or syllables. The word DCGS has four letters and is spoken in one syllable. But DCGS has _____ parts that have meanings: the root DCG and (how many?)
the suffix -s.
-

10. two 10. The word BOXES happens to have the same number of syllables as it has meaningful parts:
two syllables, BOX and -ES; _____ meaningful parts,
BOX and -ES.
-

11. meaning 11. When we add the suffix -ES to a word, we add the meaning "more than one." When we add the suffix -ES to the word FOX, we add the m _____ "more than one" to the meaning of FOX.
-

12. meaning 12. When we subtract the suffix -s from a word, we subtract the meaning "more than one."
CARS = more than one car. Subtract -s, and CAR\$ = car.
When we subtract the suffix -s, we subtract the _____
"more than one."
-

13. ga 13. The suffix -s adds the meaning "more than one," but the letter s is not always a suffix. The word GAS ends with the letter s. If you subtract the s from GAS, what do you have left? __ __
-

14. is not 14. The letter s is a suffix only if it adds the meaning "more than one" to the word's meaning. We certainly cannot say that the s in GAS adds the meaning "more than one" to GA. So s is, is not a suffix in the word GAS.
-

15. be 15. You can make small words from larger words, but you cannot always guess the meaning of the larger word from the smaller ones. The first two letters of BED make the smaller word __ __, which has nothing to do with the meaning of BED.
-

-
16. doll 16. The parts called prefixes, roots, and suffixes have meanings that add up to the meaning of the whole word.
For instance: DCG + S means "more than one dog."
A smaller word is spelled with the first four letters of DOLLAR. It is the word .
-
17. do 17. We use the same 26 letters to spell all our words. It is not surprising, therefore, that we can find a smaller word in some longer words. Two letters in the word DOLL spell a smaller word. The little word tells us nothing about the meaning of DOLL.
-
18. no 18. The smaller word spelled with the first four letters of DOLLAR is DOLL. You know what DOLLAR and DOLL mean. Does the smaller word DOLL tell you anything about the meaning of the longer word DOLLAR? (yes or no)
-
19. meaning 19. A root is a part of a word that tells you a great deal about the meaning of the whole word. The little word DO does not tell you anything about the m of DOLL because DO is not a root in the word DOLL.
-
20. root 20. Only a part of a word that tells you a great deal about the meaning of the whole word can be a root of that word. Since the word DOLL tells you nothing about the meaning of the word DOLLAR, it is not the r of the word DOLLAR.
-
21. meaning 21. We can divide the word TREES into the letters TRE and -ES. This is a mistake, because TRE does not tell us anything about the meaning of TREES. If we divide it correctly, into TREE and -S, we will have two parts that tell us the m of the whole word TREES.
-
22. no 22. We can divide the word TEACHER into TEA and -CHER. You know what TEACHER means and what TEA means. Can TEA be the root of TEACHER? (yes or no)
-
23. meaning 23. If we divide TEACHER into TEACH and -ER, we get parts that we call the root and the suffix. TEACH is the root of TEACHER because the meaning of TEACH tells you a great deal about the g of TEACHER.
-

APPENDIX 3

SAMPLE QUESTIONS FROM THE TEST

8.

PROGRAMED LEARNING: A FOLLOW-UP STUDY

Final Test

Part I

A. 1. Where does a prefix go, and what does it do?

2. Where does a suffix go, and what does it do?

B. Answer true or false (write T or F): on line next to number.

- _____ 1. A word may have more than one suffix. _____
- _____ 2. A word may have more than one prefix. _____
- _____ 3. A word may have more than one root. _____
- _____ 4. A word with two parts may have no root. _____
- _____ 5. A word with two parts may have no prefix. _____
- _____ 6. A word with two parts may have no suffix. _____
- _____ 7. If a root changes in form, its definition changes. _____
- _____ 8. If a word begins with the letters RE, the RE is always a prefix. _____
- _____ 9. Look-alikes have the same definition. _____
- _____ 10. The letters POS make the root of POSSIBLE. _____

C. Choose the best answer and put letter on line next to number:

- _____ 1. The best definition of most prefixes would be a kind of word called a
 - a) noun
 - b) preposition
 - c) verb
 - d) adjective
- _____ 2. The historical meaning of a word is
 - a) its meaning in modern English
 - b) its meaning in history books
 - c) its meaning in Latin
 - d) its meaning in its original language

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- _____ 3. A compound root is
a) a unit made up of two roots
b) the root of a compound word
c) a root of two syllables in length
d) a root put between a prefix and a suffix
- _____ 4. Look-alike prefixes have
a) the same meaning
b) the same spelling
c) the same meaning and the same spelling
d) neither the same meaning nor the same spelling
- _____ 5. The definition of the parts of RESPECT gives us
a) "look up to"
b) "feel awed by"
c) "look back"
d) "think of"
- _____ 6. The parts PON in OPPONENT and POSIT in DEPOSIT are
a) look-alikes
b) different roots with the same meaning
c) different forms of the same root
d) different roots with different meanings
- _____ 7. A composite is
a) a part of a whole
b) a person who writes music
c) a group of unlike things
d) money in the bank
- _____ 8. An imposition is
a) a place to be
b) an insider in the group
c) what a writer of music creates
d) an extra bother in your life
- _____ 9. An emigrant is a
a) person who left his country
b) fish traveling upstream
c) newcomer to the group
d) bird going south
- _____ 10. A detraction is
a) a TV show
b) an apology
c) a nasty remark
d) an operation in arithmetic

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- _____ 11. A component is a
a) person on the other side
b) hole in a part
c) well-written tune
d) part of a whole

- _____ 12. Migratory animals
a) sleep all winter
b) have only one offspring
c) travel a great deal
d) live by themselves

D. Tell what each of these parts means in the word given. Do not define the other part of the word or the whole word. Example: UN- in UNKNOWN means "not"

1. IN- in INDUCT means _____
2. POSIT in DEPOSIT means _____
3. PEL in DISPEL means _____
4. RE- in RETRACT means _____
5. MIGR in MIGRATE means _____
6. CON- in CONDUCT means _____
7. TRACT in DISTRACT means _____
8. DE- in DEPOSE means _____
9. EX- in EXPECT means _____
10. SPECT in RESPECT means _____
11. DIS- in DISMISS means _____
12. POS in DISPOSE means _____
13. SUB- in SUBDUE means _____
14. TERR in TERRESTRIAL means _____
15. PRO- in PROPEL means _____

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APPENDIX 4

SAMPLE PAGES FROM ANSWER BOOKLET

W O R D S

DO NOT WRITE in your
programed text.
Chapter One

Chapter One, Two
and Three

DO NOT write in your
programed text.

1. _____s.

2. _____.

3. word__.

4. _____
(where)

5. a) ____ _;
b) suffix____,

6. s__ff__x.

7. box____.

8. ____ _ ,
suffix____ _ ,

(your name)

(your school)

(today's date)

(class number)

DO NOT write in your
programed text.
Chapter One

9. _____
(how many?)
10. _____
11. m _____
12. _____
13. _____
14. /is, is not/
(circle one)
15. _____,
16. _____.
17. _____

DO NOT write in your
programed text.
Chapter One

18. _____ (yes or no)
19. m _____
20. r _____
21. m _____
22. _____ (yes or no)
23. _____g
24. _____

25. _____
26. _____.
27. _____.

DO NOT write in your
programed text.
Chapter One

28. _____ f _____.

29. _____.

(how many?)

30. _____.

31. _____
(where)

32. _____
_____.

33. s _____

34. "_____."

35. _____

36. "_____"

37. _____.
_____.

38. _____,
s _____ s.

DO NOT write in your
programed text.
Chapter One

39. _____.
_____ f _____

40. [the same, different]
(circle one)

41. _____,
_____s

42. rest _____
rest _____

43. _____.

44. _____.

45. _____.
_____s

46. _____.

47. _____.